



كلية الحاسبات والذكاء الاصطناعي

BS111

Probability and Statistics

Lecture 07

Dr. Ahmed Hagag

Faculty of Computers and Artificial Intelligence
Benha University

Spring 2019-2020



Chapter 2: Random Variable

- Discrete Random Variables.
- Probability Mass Functions.
- Cumulative Distribution Functions.
- Discrete R.V. (Mean and Variance).
- Continuous Random Variables.
- Probability Density Functions.
- Continuous R.V. (Mean and Variance).
- Joint Probability Distributions.



Joint Probability Mass Function:

If X and Y are two discrete random variables, the **joint probability mass function** is denoted as $f_{XY}(x, y)$, satisfies

$$1) f_{XY}(x, y) \geq 0$$

$$2) \sum_X \sum_Y f_{XY}(x, y) = 1$$

$$3) f_{XY}(x, y) = P(X = x, Y = y)$$



Joint Prob. Mass Fun. (2/15)

Review Example

$$S = \{HH, HT, TH, TT\}$$

X 2 1 1 0

number of heads

Y 0 1 1 2

number of tails

$y \backslash x$	0	1	2
0	0	0	1/4
1	0	2/4	0
2	1/4	0	0

joint probability mass function $f_{XY}(x, y)$

Marginal Probability Distributions (Discrete):

The marginal distributions of the random variable X alone is:

$$f_X(x) = \sum_y f_{XY}(x, y)$$

The marginal distributions of the random variable Y alone is:

$$f_Y(y) = \sum_x f_{XY}(x, y)$$



Joint Prob. Mass Fun. (4/15)

Review Example (1/4):

$f_X(x)$

$y \backslash x$	0	1	2
0	0	0	1/4
1	0	2/4	0
2	1/4	0	0
$f_X(x)$	1/4	2/4	1/4



Joint Prob. Mass Fun. (4/15)

Review Example (2/4):

$f_X(x)$

x	0	1	2
$f_X(x)$	1/4	2/4	1/4



Joint Prob. Mass Fun. (4/15)

Review Example (3/4):

$f_Y(y)$

$y \backslash x$	0	1	2	$f_Y(y)$
0	0	0	1/4	1/4
1	0	2/4	0	2/4
2	1/4	0	0	1/4



Joint Prob. Mass Fun. (4/15)

Review Example (4/4):

$f_Y(y)$

y	0	1	2
$f_Y(y)$	1/4	2/4	1/4



Mean from a Joint Distribution (Discrete):

Mean for the random variable X alone is:

$$E(X) = \sum_x x f_X(x)$$

Mean for the random variable Y alone is:

$$E(Y) = \sum_y y f_Y(y)$$



Variance from a Joint Distribution (Discrete):

Variance for the random variable X alone is:

$$V(X) = E(X^2) - (E(X))^2$$

$$\text{and s.d. of } X = \sigma_X = \sqrt{V(X)}$$

Variance for the random variable Y alone is:

$$V(Y) = E(Y^2) - (E(Y))^2$$

$$\text{and s.d. of } Y = \sigma_Y = \sqrt{V(Y)}$$



Joint Prob. Mass Fun. (7/15)

Example1 (1/4): (from the previous example)

$f_X(x)$

x	0	1	2
$f_X(x)$	1/4	2/4	1/4

Find:

$E(X)$

$V(X)$

σ_X

Joint Prob. Mass Fun. (7/15)

Example1 (2/4): (from the previous example)

$f_X(x)$

x	0	1	2
$f_X(x)$	1/4	2/4	1/4

1:

$$E(X) = \sum_x x f_X(x) = (0) \left(\frac{1}{4} \right) + (1) \left(\frac{2}{4} \right) + (2) \left(\frac{1}{4} \right) = 1$$

Joint Prob. Mass Fun. (7/15)

Example1 (3/4): (from the previous example)

$f_X(x)$

x	0	1	2
$f_X(x)$	1/4	2/4	1/4

2:

$$V(X) = E(X^2) - (E(X))^2$$

$$E(X^2) = (0) \left(\frac{1}{4} \right) + (1) \left(\frac{2}{4} \right) + (4) \left(\frac{1}{4} \right) = \frac{6}{4} = 1.5$$

Joint Prob. Mass Fun. (7/15)

Example1 (3/4): (from the previous example)

$f_X(x)$

x	0	1	2
$f_X(x)$	1/4	2/4	1/4

2:

$$E(X^2) = (0) \left(\frac{1}{4} \right) + (1) \left(\frac{2}{4} \right) + (4) \left(\frac{1}{4} \right) = \frac{6}{4} = 1.5$$

$$V(X) = 1.5 - (1)^2 = 0.5$$

Joint Prob. Mass Fun. (7/15)

Example1 (4/4): (from the previous example)

$f_X(x)$

x	0	1	2
$f_X(x)$	1/4	2/4	1/4

3:

$$V(X) = 1.5 - (1)^2 = 0.5$$

$$\sigma_X = \sqrt{0.5} = 0.7071$$



Conditional Probability Distributions (Discrete):

The random variables X and Y are discrete, the conditional probability mass function of X given $Y = y$ is:

$$f_{X|Y}(x) = \frac{f_{XY}(x, y)}{f_Y(y)}$$

$$\text{for } f_Y(y) > 0$$

Conditional Probability Distributions (Discrete):

The random variables X and Y are discrete, the conditional probability mass function of X given $Y = y$ is:

$$f_{X|Y}(x) = \frac{f_{XY}(x, y)}{f_Y(y)}$$

1

$$f_{X|2}(x) = f_{X|Y=2}(x) = f_{XY}(x, 2) / f_Y(2)$$

The conditional probability distribution of X given that $Y = 2$.

Conditional Probability Distributions (Discrete):

The random variables X and Y are discrete, the conditional probability mass function of X given $Y = y$ is:

$$f_{X|Y}(x) = \frac{f_{XY}(x, y)}{f_Y(y)}$$

2

$$f_{Y|X=3}(y) = f_{Y|X=3}(y) = f_{XY}(3, y) / f_X(3)$$

The conditional probability distribution of Y given that $X = 3$.



Joint Prob. Mass Fun. (11/15)

Example2:

$$f_{XY}(x, y)$$

Find:

$$f_X(x)$$

$$E(Y)$$

$$\sigma_X$$

$$f_{X|3}(x)$$

$$f_{Y|1.5}(y)$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (1/17):

$$f_{XY}(x, y)$$

1:

$f_X(x) \rightarrow$ marginal X

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8
$f_X(x)$	1/4	3/8	1/4	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (1/17):

x	1	1.5	2.5	3
$f_X(x)$	1/4	3/8	1/4	1/8

1:

$f_X(x) \rightarrow$ marginal X



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (2/17):

$$f_{XY}(x, y)$$

2:

$$E(Y) \rightarrow \text{Mean } Y$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (2/17):

$$f_{XY}(x, y)$$

2:

$$E(Y) = \sum_y y f_Y(y)$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (3/17):

$f_{XY}(x, y)$

2:

$$E(Y) = \sum_y y f_Y(y)$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (3/17):

2:

$$E(Y) = \sum_y y f_Y(y)$$

y	$f_Y(y)$
1	1/4
2	1/8
3	1/4
4	1/4
5	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (4/17):

2:

$$E(Y) = \sum_y y f_Y(y)$$

y	$f_Y(y)$
1	1/4
2	1/8
3	1/4
4	1/4
5	1/8

$$E(Y) = (1) \left(\frac{1}{4} \right) + (2) \left(\frac{1}{8} \right) + (3) \left(\frac{1}{4} \right) + (4) \left(\frac{1}{4} \right) + (5) \left(\frac{1}{8} \right) = \frac{23}{8}$$

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (4/17):

2:

$$E(Y) = \sum_y y f_Y(y)$$

$$E(Y) = \frac{23}{8} = 2.875$$

y	$f_Y(y)$
1	1/4
2	1/8
3	1/4
4	1/4
5	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (5/17):

$$f_{XY}(x, y)$$

3:

$\sigma_X \rightarrow$ s.d. of X

$$= \sqrt{V(X)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (5/17):

$$f_{XY}(x, y)$$

3:

$\sigma_X \rightarrow$ s.d. of X

$$= \sqrt{V(X)} \rightarrow = E(X^2) - (E(X))^2$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (6/17):

Recall

x	1	1.5	2.5	3
$f_X(x)$	1/4	3/8	1/4	1/8

1:

$f_X(x) \rightarrow$ marginal X

3:

$\sigma_X \rightarrow$ s.d. of X

$$= \sqrt{V(X)}$$

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (7/17):

Recall

x	1	1.5	2.5	3
$f_X(x)$	1/4	3/8	1/4	1/8

1: $f_X(x) \rightarrow \text{marginal } X$ 3: $\sigma_X \rightarrow \text{s.d. of } X$

$$= \sqrt{V(X)}$$

$$E(X) = \sum_x x f_X(x)$$

$$= (1) \left(\frac{1}{4} \right) + (1.5) \left(\frac{3}{8} \right) + (2.5) \left(\frac{1}{4} \right) + (3) \left(\frac{1}{8} \right) = 1.8125$$

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (8/17):

Recall

x	1	1.5	2.5	3
$f_X(x)$	1/4	3/8	1/4	1/8

1:

$f_X(x) \rightarrow$ marginal X

3:

$\sigma_X \rightarrow$ s.d. of X

$$= \sqrt{V(X)}$$

$$E(X^2) = \sum_x x^2 f_X(x)$$

$$= (1) \left(\frac{1}{4} \right) + (2.25) \left(\frac{3}{8} \right) + (6.25) \left(\frac{1}{4} \right) + (9) \left(\frac{1}{8} \right)$$

$$= 3.78125$$



Example2 – Answer (9/17):

$$E(X) = 1.8125$$

$$E(X^2) = 3.78125$$

3:

$\sigma_X \rightarrow$ s.d. of X

$$V(X) = 3.78125 - (1.8125)^2 = 0.49609375$$

$$\sigma_X = \sqrt{0.49609375} = 0.704339$$



Example2 – Answer (10/17):

4:

$$f_{X|3}(x)$$

The conditional probability distribution of X given that $Y = 3$.



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (11/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$f_{X|y}(x) = \frac{f_{XY}(x, y)}{f_Y(y)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (11/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$y = 3$$

$$f_{X|y}(x) = \frac{f_{XY}(x, y)}{f_Y(y)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (11/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$f_{X|3}(x) = \frac{f_{XY}(x, 3)}{f_Y(3)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (12/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$f_{X|3}(x) = \frac{f_{XY}(x, 3)}{f_Y(3)}$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (12/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$y = 3$$

$$f_{X|3}(x) = \frac{f_{XY}(x, 3)}{f_Y(3)}$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (13/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$y = 3$$

$$f_{X|3}(1) = \frac{f_{XY}(1,3)}{f_Y(3)} = \frac{0}{1/4}$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8
$f_{X 3}(x)$	0				



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (13/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$y = 3$$

$$f_{X|3}(1.5) = \frac{f_{XY}(1.5, 3)}{f_Y(3)} = \frac{1/4}{1/4}$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8
$f_{X 3}(x)$	0	1			



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (13/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$y = 3$$

$$f_{X|3}(2.5) = \frac{f_{XY}(2.5, 3)}{f_Y(3)} = \frac{0}{1/4}$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8
$f_{X 3}(x)$	0	1	0		



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (13/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

$$y = 3$$

$$f_{X|3}(3) = \frac{f_{XY}(3,3)}{f_Y(3)} = \frac{0}{1/4}$$

$y \backslash x$	1	1.5	2.5	3	$f_Y(y)$
1	1/4	0	0	0	1/4
2	0	1/8	0	0	1/8
3	0	1/4	0	0	1/4
4	0	0	1/4	0	1/4
5	0	0	0	1/8	1/8
$f_{X 3}(x)$	0	1	0	0	



Example2 – Answer (13/17):

$$f_{XY}(x, y)$$

4:

$$f_{X|3}(x)$$

x	1	1.5	2.5	3
$f_{X 3}(x)$	0	1	0	0

$$f_{X|3}(x) = \frac{f_{XY}(x, 3)}{f_Y(3)}$$



Example2 – Answer (14/17):

5:

$$f_{Y|1.5}(y)$$

The conditional probability distribution of Y given that $X = 1.5$.



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (15/17):

$$f_{XY}(x, y)$$

5:

$$f_{Y|1.5}(y)$$

$$f_{Y|x}(y) = \frac{f_{XY}(x, y)}{f_X(x)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (15/17):

$$f_{XY}(x, y)$$

5:

$$f_{Y|1.5}(y)$$

$$x = 1.5$$

$$f_{Y|x}(y) = \frac{f_{XY}(x, y)}{f_X(x)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (15/17):

$$f_{XY}(x, y)$$

5:

$$f_{Y|1.5}(y)$$

$$f_{Y|1.5}(y) = \frac{f_{XY}(1.5, y)}{f_X(1.5)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (16/17):

$$x = 1.5$$

$$f_{XY}(x, y)$$

5:

$$f_{Y|1.5}(y)$$

$$f_{Y|1.5}(y) = \frac{f_{XY}(1.5, y)}{f_X(1.5)}$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8
$f_X(x)$	1/4	3/8	1/4	1/8



Joint Prob. Mass Fun. (12/15)

Example2 – Answer (17/17):

$$x = 1.5$$

$$f_{XY}(x, y)$$

5:

$$f_{Y|1.5}(y)$$

$$f_{Y|1.5}(y) = \frac{f_{XY}(1.5, y)}{f_X(1.5)}$$

$y \backslash x$	1	1.5	2.5	3	$f_{Y 1.5}(y)$
1	1/4	0	0	0	0
2	0	1/8	0	0	1/3
3	0	1/4	0	0	2/3
4	0	0	1/4	0	0
5	0	0	0	1/8	0
$f_X(x)$	1/4	3/8	1/4	1/8	

Joint Prob. Mass Fun. (12/15)

Example2 – Answer (17/17):

5:

$$f_{Y|1.5}(y)$$

$$f_{Y|1.5}(y) = \frac{f_{XY}(1.5, y)}{f_X(1.5)}$$

y	$f_{Y 1.5}(y)$
1	0
2	1/3
3	2/3
4	0
5	0



Conditional Mean and Variance (Discrete):

The conditional mean of X given $Y = y$:

$$E(X | y) = \sum_x x f_{X|y}(x)$$

The conditional variance of X given $Y = y$:

$$V(X | y) = \sum_x x^2 f_{X|y}(x) - \left(\sum_x x f_{X|y}(x) \right)^2$$



Joint Prob. Mass Fun. (14/15)

Example3:

$$f_X(x)$$

Find:

$$E(X | 3)$$

$$V(X | 3)$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8



Joint Prob. Mass Fun. (15/15)

Example3 – Answer (1/7):

$$f_{XY}(x, y)$$

1:

$$E(X | 3)$$

$$E(X | y) = \sum_x x f_{X|y}(x)$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

Joint Prob. Mass Fun. (15/15)

Example3 – Answer (1/7):

$$f_{XY}(x, y)$$

1:

$$E(X | 3)$$

$y = 3$

$$E(X | 3) = \sum_x x f_{X|3}(x)$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

Joint Prob. Mass Fun. (15/15)

Example3 – Answer (2/7):

Recall

1:

$$E(X | 3)$$

$y = 3$

$$E(X | 3) = \sum_x x f_{X|3}(x)$$

4:

$$f_{X|3}(x)$$

x	1	1.5	2.5	3
$f_{X 3}(x)$	0	1	0	0

Joint Prob. Mass Fun. (15/15)

Example3 – Answer (3/7):

Recall1:

$$E(X | 3)$$

4:

$$f_{X|3}(x)$$

x	1	1.5	2.5	3
$f_{X 3}(x)$	0	1	0	0

$$E(X | 3) = \sum_x x f_{X|3}(x)$$

$$= (1)(0) + (1.5)(1) + (2.5)(0) + (3)(0) = 1.5$$



Joint Prob. Mass Fun. (15/15)

Example3 – Answer (4/7):

$$f_{XY}(x, y)$$

2:

$$V(X | 3)$$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

$$V(X | y) = \sum_x x^2 f_{X|y}(x) - \left(\sum_x x f_{X|y}(x) \right)^2$$



Joint Prob. Mass Fun. (15/15)

Example3 – Answer (4/7):

$$f_{XY}(x, y)$$

2:

$$V(X | 3)$$

$y = 3$

$y \backslash x$	1	1.5	2.5	3
1	1/4	0	0	0
2	0	1/8	0	0
3	0	1/4	0	0
4	0	0	1/4	0
5	0	0	0	1/8

$$V(X | 3) = \sum_x x^2 f_{X|3}(x) - \left(\sum_x x f_{X|3}(x) \right)^2$$

Example3 – Answer (5/7):

Recall

$$E(X | 3) = \sum_x x f_{X|3}(x) = 1.5$$

2:

$V(X | 3)$

$y = 3$

$$V(X | 3) = \sum_x x^2 f_{X|3}(x) - (1.5)^2$$

Example3 – Answer (6/7):

Recall

2:

$$V(X | 3)$$

4:

$$f_{X|3}(x)$$

x	1	1.5	2.5	3
$f_{X 3}(x)$	0	1	0	0

$$\sum_x x^2 f_{X|3}(x) = (1)(0) + (2.25)(1) + (6.25)(0) + (9)(0) = 2.25$$

$$V(X | 3) = \sum_x x^2 f_{X|3}(x) - (1.5)^2$$



Example3 – Answer (7/7):

2:

$$V(X | 3)$$

$$\sum_x x^2 f_{X|3}(x) = (1)(0) + (2.25)(1) + (6.25)(0) + (9)(0) = 2.25$$

$$V(X | 3) = 2.25 - (1.5)^2 = 0$$



Video Lectures

All Lectures: https://www.youtube.com/playlist?list=PLxlvc-MG0s6gW9SgkmoxE5w9vQkIDl_r-

Lecture #7: https://www.youtube.com/watch?v=vZLUoC_03xs&list=PLxlvc-MG0s6gW9SgkmoxE5w9vQkIDl_r-&index=8

Thank You

Dr. Ahmed Hagag

ahagag@fci.bu.edu.eg